TOOTHBRUSHES WITH A REPLACEABLE HEAD HAVING A THREADED CONNECTION

JOHN GEOFFREY CHAN

This application claims the benefit of U.S. Provisional Application No. 60/410,853, filed September 13, 2002, the substance of which is incorporated herein by reference.

Field of the Invention

The present invention relates to the field of toothbrushes, and more particularly, the invention relates to the field of electrically powered toothbrushes.

Background of the Invention

Electric toothbrushes are known that utilize a replaceable or interchangeable brush head which is releasably engageable with a handle or body portion. For example, U.S. Patent 5,404,608 to Hommann discloses an electric toothbrush having a handle with a push-on brush component. U.S. Patents 4,880,382 to Moret et al. and 5,435,034 to Bigler et al. disclose electric toothbrushes having brush heads that are replaceable and removable from a handle or body portion of the brush. Both the '382 patent and the '034 patent utilize a slotted engagement mechanism between the brush head and the handle portion of the brush. U.S. Patent 5,465,444 to Bigler et al. describes an electric toothbrush having a brush head that is said to "slip-on" a handle portion.

Although satisfactory in many respects, a need exists for an electric toothbrush having a removable brush head that may be securely and easily engaged with a handle or body portion of the toothbrush that is more compact compact and robust.

Summary of the Invention

An electric toothbrush is provided. The electric toothbrush has a housing defining a hollow interior having a motor and a first shaft disposed therein that is operatively connected to the motor. The housing has an engagement member extending along a longitudinal axis of the housing from an end thereof. The

engagement member includes a first thread helically extending the said engagement member.

A brush head is releasably connected to the handle. The brush head has a movable bristle carrier at a first end and a second shaft operatively connected to the movable bristle carrier. The brush head has a receiving region at a second end of the brush head opposite the first end. The receiving region has an engagement surface with a second thread helically extending along the annular engagement surface. The first thread and second thread form a threaded connection that releasably couples the brush head to the handle when one of the handle or the brush head is rotated about the longitudinal axis.

Brief Description of the Drawings

The present invention may take form in various components and arrangements of components, and in various techniques, methods, or procedures and arrangements of steps. The referenced drawings are only for purposes of illustrating preferred embodiments, they are not necessarily to scale, and are not to be construed as limiting the present invention.

It is believed that the present invention will be better understood from the following description taken in conjunction with the accompanying drawings in which:

Fig. **1** is a perspective view of a preferred embodiment electric toothbrush in accordance with the present invention.

Fig. **2** is a perspective view of the preferred embodiment toothbrush shown in Fig. **1** in a partially disassembled state in which the brush head is removed from the body portion of the brush.

Fig. **3** is a partial side view of the toothbrush shown in Figs. **1** and **2** detailing the engagement of the brush head and the body or handle portion of the brush.

Fig. **4** is a detailed view illustrating the engagement and orientation of the brush head and handle portion of the toothbrush shown in Fig. **3**, in which the components are separated from one another.

Fig. **5** is an end view of the brush head component shown in Fig. **4**, taken with respect to line **5,5**.

Fig. **6** is an end view of the handle portion of the brush assembly shown in Fig. **4** taken along line **6,6**.

Figs. **7A** to **7C** are cross-sectional side views showing engagement of first and second shafts.

Detailed Description of the Preferred Embodiments

All patents and patent publications referenced herein, including U.S. Provisional Application No. 60/410,853, filed September 13, 2002, are incorporated herein by reference. Figs. **1** and **2** illustrate a preferred embodiment electric toothbrush **10** in accordance with the present invention. The preferred embodiment toothbrush **10** comprises a handle or body portion **30**, an end cap **20** disposed at one end of the handle portion **30**, and a brush head **40** disposed at an end opposite the end at which the end cap **20** is disposed. The handle **30** preferably defines a hollow interior region that is accessible from an open end defined at the end of the handle at which the end cap **20** is disposed. The hollow interior region defined within the handle **30** is also accessible from the end to which the brush head **40** is attached. The preferred embodiment toothbrush **10** also comprises a plurality of bristles **50** disposed on or near a distal-most end of the brush head **40**. Most preferably, a movable bristle carrier is disposed on the end of the brush head that is driven by an electric motor disposed within the handle **30**. The bristle carrier preferably supports and retains a collection of bristles that move along with the movable bristle carrier during operation of the electric toothbrush. Most preferably, the plurality of bristles **50** contain these movable bristles, and additionally include stationary or static bristles that are disposed along the brush head and preferably around the movable bristle carrier and its bristles. The preferred embodiment toothbrush **10** also includes an actuator or switch **60** accessible along the exterior of the handle **30** for actuating the motor disposed within the interior of the toothbrush **10**. A drive mechanism operatively interconnects the motor and movable bristle carrier to impart movement, e.g. translational or oscillating movement, to the movable bristle carrier upon actuation of the motor by the switch **60**. The present invention is not particularly directed to the bristles disposed on the brush head or the configuration of the movable bristle carrier and so extensive description of those aspects are not set forth herein. These aspects are the subjects of many of the Assignee's other patent applications and patents.

Fig. **2** illustrates the preferred embodiment electric toothbrush **10** in a partially disassembled state in which the brush head **40** is removed and separated from the handle portion **30**. It can be seen that the handle portion **30** includes an engagement member **32** extending in a direction generally along the longitudinal axis of the toothbrush. The longitudinal axis is shown in Fig. **2** as axis **L**. Defined along this end of the handle **30** is a shoulder region formed from an annular surface **34** that extends from the main exterior of the housing **30**, designated as the handle outer surface **31**, to the engagement member **32**. The corner or boundary between the generally smooth contoured handle outer surface **31** and the annular surface **34** is designated as corner **36**. As will be appreciated, the corner **36** extends about the periphery of the handle **30** and generally separates the outer contoured surface of the handle **30** from the annular surface **34**. The brush head **40** provides a distal end **42** which, upon engagement with the handle **30** of the toothbrush **10**, generally borders or is immediately adjacent to the corner **36** of the handle **30**.

Fig. **3** is a detailed side view of a portion of the handle **30** and the brush head **40**, further illustrating the engagement between those two components. Fig. **3** illustrates that the engagement member **32** is received and retained within a receiving region defined within an end of the brush head **40**. Preferably, the outer surface of the brush head **40** is contoured and sloping in the same manner as the outer surface of the handle **30**. The brush head outer surface is designated as **41** in the referenced figures. Most preferably, the outer contours of the two components, i.e. the brush head **40** and the handle **30**, are such that when those components are engaged with each other as shown in Fig. **3**, a single, continuous common surface is formed from the outer surfaces of the components, i.e. surfaces **31** and **41**. That is, the degree of contour or slope of an outer surface of one of the components is continued and exhibited by the other component engaged thereto.

Fig. **4** details the engagement structures between the brush head **40** and the handle portion **30**, and illustrates those components as separated from one another. Specifically, the handle or body portion **30** includes the annular surface **34**, from which extends the engagement member **32**. The engagement member **32** is preferably in the shape of a cylinder, although conical configurations are also encompassed by the present invention. The engagement member **32** preferably extends along and is concentrically disposed about the longitudinal axis **L** of the toothbrush. Defined along the cylindrically shaped engagement member **32** is a

screw member or thread **33** that is oriented such that it extends generally radially outward from an outer surface **35** of the engagement member **32**. The thread **33** helically extends along the length of the engagement member **32**, or substantially so. The thread **33** has a major diameter, a minor diameter, a pitch diameter, and a pitch. The thread engages a corresponding thread **44** disposed on brush head **40**. The thread is configured to facilitate engagement between a first shaft disposed within the handle **30** and a second shaft disposed within the brush head **40**, as discussed more fully hereafter. The first and second shafts can reciprocate, rotate, oscillate, or gyrate to transmit motion from an electric motor in the handle to the movable bristle carrier disposed at the end of the brush head **40**.

With regard to the brush head **40**, a recessed receiving region is generally defined within the distal end **42** of that component. A sealing lip **45** extends around the periphery of the distal end **42** of the brush head **40**. An annular engagement surface **43** having a complimentary screw member or thread **44** projecting from its cavity walls is provided within the receiving region, adjacent the sealing lip **45**. That is, the thread **44** projects from the surface **43**, toward the interior of the receiving region defined in part by the surface **43**. The thread **44** helically extends along the annular engagement surface **43**. The thread **44** engages to thereby form a threaded connection between the brush head **40** and handle **30**. The thread **44** can be provided as either a male thread or a female thread as can the thread **33** of the engagement member **32**. The brush head **40** further defines a channel **49** extending from the annular engagement surface **43** within its interior, and preferably extending co-linearly with the longitudinal axis **L** of the toothbrush **10**.

Fig. **5** is an end view of the brush head **40**. The brush head **40**, as previously noted, includes a sealing lip **45** that extends inward from the distal end **42**. The sealing lip **45** leads to the annular engagement surface **43**. That surface, i.e. the annular engagement surface **43**, extends between the sealing lip **45** and the channel **49** extending within the interior of the brush head. A stop surface **41** is provided between the entrance to the channel **49** and the annular engagement surface **43**. The stop surface is preferably oriented and generally perpendicular to the longitudinal axis of the toothbrush **10**.

Fig. **6** illustrates an end view of the preferred embodiment handle **30** of the brush **10**. Fig. **6** illustrates the outer surface **31** of the handle **30** as it extends

to the corner **36**. Fig. **6** further illustrates the annular surface **34** extending between the corner **36** and the cylindrically shaped engagement member **32** having a thread **33** formed thereon. Fig. **6** also illustrates an annular sealing surface **37**. The sealing surface is generally defined along the distal end of the engagement member **32**.

Insertion of the engagement member **32** within that receiving region is achieved by rotating one of the handle **30** or the brush head **40** with respect to the other. Accordingly, upon insertion, the engagement member **32**, and thus the handle **30**, may not be withdrawn from the brush head **40**. Withdrawal or separation of the components **30** and **40** is achieved by rotating, in an opposite direction, one component with respect to the other. It will be understood that the helical orientation of each of the threads **33** and **44** is the same so that one thread may slide or otherwise be translated past the other.

As previously noted, it is preferred that a motor, power source, and drive mechanism be disposed within the hollow interior region defined within the handle **30** of the preferred embodiment toothbrush. A wide array of drive motor and gearing configurations may be utilized in the preferred embodiment toothbrushes described herein. For example, various drive mechanisms described in US Publication No. 20020162180A1 and U.S. Patents 6,178,579; 6,189,693; 6,360,395; and 6,371,294 may be suitable. The drive mechanism includes a first shaft **50** (Fig. **7**) disposed within the handle that is operatively connected to the motor. An interconnecting structure is provided that releasably couples the first shaft in the handle **30** with a second shaft **52** in the brush head **40** so that motion is transmitted from the motor (not shown) to the movable bristle carrier on the brush head **40**. The interconnecting structure should both couple the first and second shafts and be compatible with the rotational movement associated with engagement of the threads **33** and **44**.

Referring to Fig. **7**, a preferred interconnecting structure for coupling the first shaft **50** in the handle **30** and the second shaft **52** of the brush head **40** that is suitable for use with the threads **33** and **44** is illustrated. The interconnecting structure couples the first and second shafts when the brush head **40** threadedly engages the handle **30**. The interconnecting structure comprises a notch **54** on the first shaft **50** and a radially extending tab **58** that engages the notch **54** to couple the first and second shafts **50** and **52**. The tab **58** extends from an arm **59**

connected to the second shaft **52** that is offset from the centerline thereof. The tip **53** of the first shaft is substantially cylindrical in shape so that the tab **58** can easily traverse the outer surface of the first shaft as the brush head **40** is rotated through the engagement length of the threads **33** and **44**. The distal most end of the first shaft **50** is also rounded or chamfered to facilitate guiding the tab **58** onto the outer cylindrical surface of the first shaft **50**. The second shaft **52** should be flexible and resilient or otherwise deflectable enough to permit the extension **56** to be radially displaced, as best seen in Fig. **7B**. A spring **57** can be provided in the brush head **40** to radially bias the second shaft **52** in order to accommodate the deflection of the second shaft **52**. An annular gap **62** is provided between the first shaft **50** and the inner surface **64** of the handle **30** that is sufficient to permit the tab **58** and least a portion of said arm **59** to pass there through. The annular gap **62** preferably extends about the entire outer surface of the first shaft **50** (i.e., about the entire perimeter or circumference (if cylindrical) of the first shaft **50**), although the gap **62** may extend about less where the brush head **40** is rotated less than 360° to engage the notch **54** and the tab **58**. As previously discussed, however, it is preferred to rotate the brush head **40** at least about 360° about the longitudinal axis L to provide sufficient engagement between the threads **33** and **44**. The pitch of the threads **33** and **44** is preferably selected to provide a smooth engagement between the notch **54** and the tab **58** (or other interconnecting structures releasably coupling the first and second shafts) as the brush head **40** is rotated and translated along the longitudinal axis L of the toothbrush. If the pitch is too low (i.e., too few threads per mm), the tab **58** and notch **54** might bind during engagement because the thread lead angle is too great. If the shafts reciprocate along the longitudinal axis L, the pitch should also be selected to accommodate the amount of travel associated with the first and second shafts so that engagement of the notch **54** and tab **58** will occur regardless whether the first or second shafts are at the beginning or end of their stroke. The pitch should also be selected to provide a reasonable amount of rotation about the longitudinal axis L so that excessive rotation of the handle 30 or brush head 40 is not required yet sufficient thread engagement is provided for strength. Preferably, the amount of rotation is between about 180° and about 540° about the longitudinal axis L of the toothbrush **10**. In another embodiment, the pitch is selected to provide between about 270° and about 450° of

rotation about the longitudinal axis L of the toothbrush **10**. The pitch is preferably between about 1 and about 5 mm and more preferably between about 2 and about 3 mm. A square thread profile is preferred, although other thread profiles can be used.

Techniques known to those of skill in the art, such as injection molding, can be used to manufacture the toothbrush of the present invention. The housing and the brush head may be formed from a wide array of polymers. In the following description of the preferred polymer materials for use herein, the abbreviations that are commonly used by those of skill in the art to refer to certain polymers appear in parentheses following the full names of the polymers. The polymer is preferably polypropylene ("PP"), or may be selected from the group consisting of other commercially available materials, such as polystyrene ("PS"), polyethylene ("PE"), acrylonitrile-styrene copolymer ("SAN"), and cellulose acetate propionate ("CAP"). These materials may be blended with one or more additional polymers including a thermoplastic elastomer ("TPE"), a thermoplastic olefin ("TPO"), a soft thermoplastic polyolefin (e.g., polybutylene), or may be selected from other elastomeric materials, such as etheylene-vinylacetate copolymer ("EVA"), and ethylene propylene rubber ("EPR"). Examples of suitable thermoplastic elastomers herein include styrene-ethylene-butadiene-styrene ("SEBS"), styrene-butadiene-styrene ("SBS"), and styrene-isoprene-styrene ("SIS"). Examples of suitable thermoplastic olefins herein include polybutylene ("PB"), and polyethylene ("PE").

The present invention may further utilize features, aspects, components, materials, and characteristics from one or more of the following published patent applications or issued patents: WO 01/29128; U.S. Patent 6,000,083; U.S. Des. Patent 432,312; U.S. Des. Patent 433,814; U.S. Patent 6,178,579; U.S. Patent 6,189,693; U.S. Patent 6,311,837; U.S. published patent application 2002/0032941; U.S. Patent 6,360,395; and U.S. Patent 6,371,294.

The embodiments described herein were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance

with the breadth to which they are fairly, legally and equitably entitled.